Department of Mathematics and Computer Science
University of Southern Denmark, Odense

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Marco Chiarandini

# DM560 — Introduction to Programming in C++

## Class Test 1, Autumn 2019

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YOUR NAME:

USERID:

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Each exercise gives 5 points. You start from an initial bonus of 5 points. There are 95 points to collect overall. To pass the test you need to have 50 or more points.

### Exercise 1

Complete with the missing characters:

```
   This is a single-line comment
   This is a multi-line comment
```

### Exercise 2

Complete the piece of code below with the missing words in the places where the underscores are typed:

```
int day = 4;
switch (___) {

___ 1:
    cout << "Saturday";
    break;

___ 2:
    cout << "Sunday";
    ___;

___:
    cout << "Weekend";
}
```

## Exercise 3

For each of the following programs, write what is the error and its type (compiler error, run time error, logic error, uncaught exception).

```
#include <iostream>

int main() {
  cout << "Hello World!";
  return 0;
}
```

```
#include <iostream>
#include <vector>
using namespace std;

int main() {
  vector<int> v = {1, 2, 3};
  int i=0;
  while (i<=3) {
    cout << v.at(i++);
  }
}
```

```
#include <iostream>

int calculate(int, int);

int main() {
  return calculate(3,5);
}
```

```
#include <iostream>

int main() {
  for (int i=0; i<10; i++)
  std::cout << --i << '\n';
  return 0;
}
```

## Exercise 4

Determine the type of `g` in this piece of code:

```
int a = 3;
double d = 2.19;
auto g = 4 - d + a / 2;
```

## Exercise 5

Suppose that i is a variables of a numeric type and that b is a variable of Boolean type. Remove unnecessary parentheses from the following expression.

```
(b || (!(b && (3 == (i * 2)))))
```

## Exercise 6

Find the value stored in each variable at the end of the execution:

```
int i = 3;
double d = 3.0;
d = d - 2.3;
i = (int) d;
```

d =
i =

## Exercise 7

Suppose we need to develop a program to decide the dates of the exams of all courses at the faculty of Science of SDU.
We need to work with the following data:

- Course title
- Course code/identifier
- Exam code/identifier
- Course of the exam

- Type of exam (written, oral)
- Length of the exam (number of days)
- Students registered
- Time slots of the exam (day)
- Room code/identifier
- Room capacity
- Student code/identifier
- Student registrations to exams

Propose names and types for the variables to store these data and organize them in your own user defined data types.

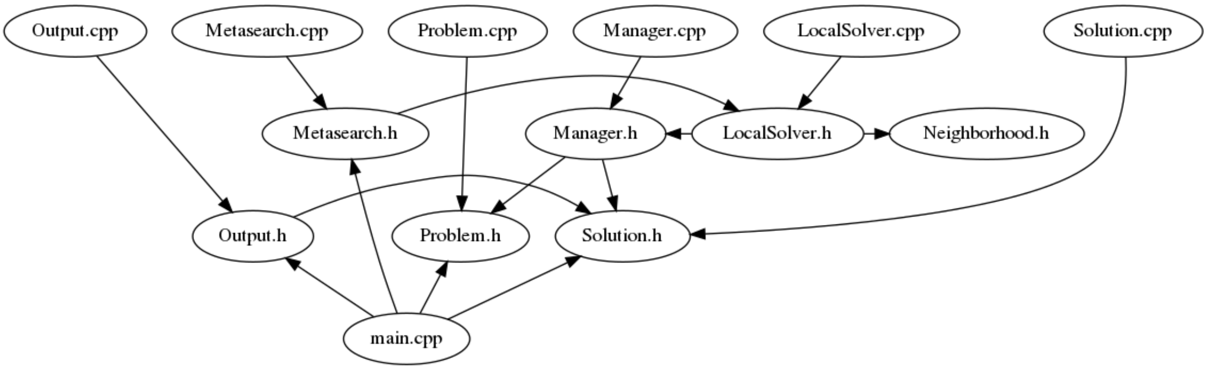
## Exercise 8

You program consists of the following files:

```
Problem.h
class Problem_data {...};
...

Solution.h
class Solution {...};
...

Output.h
```

```
#include ‘‘Solution.h’’
class Output {...};

Neighborhood.h
#include ‘‘Solution.h’’
class Neighborhood {...};

Manager.h
#include ‘‘Solution.h’’
#include ‘‘Problem.h’’
class Manager {...};
...

LocalSolver.h
#include ‘‘Manager.h’’
#include ‘‘Neighborhood.h’’
class LocalSolver {...};

Metasearch.h
#include ‘‘LocalSolver.h’’
class Metasearch {...};

main.cpp
#include ‘‘Metasearch.h’’
#include ‘‘Problem.h’’
#include ‘‘Solution.h’’
#include ‘‘Output.h’’
```

Moreover there are implementation files for the definitions contained in the headers. All together the program can be represented by the following dependency graph, where an arrow indicates the presence of an include statement in the file corresponding to the tail of the arrow of the file corresponding to the head of the arrow:



Write the commands that you would write in a shell of the Computer Lab to build the program from these files.

## Exercise 9

Consider the following conversions:

```
char happy = true; // bool to char
int sunny = true; // bool to int
double b = true; // bool to double
int a = 'a'; // char to int
double c = 'c'; // char to double
double x = 2; // int to double
int x1 = 3.5; // double to int
char c1 = 0.5; // double to char
bool b1 = 0.5; // double to bool
char c2 = 1000; // int to char
char c2 {1000}; // int to char
char c2 narrow_cast<char>{1000}; // int to char
bool b3 = 10; // int to bool
bool b3 = narrow_cast<bool>{1}; // int to bool  // compile, no exception, unsafe
bool b4 = 's'; // char to bool
```

For each of them state whether:

- it will compile or not;
- it will throw an exception or not;
- it is safe or unsafe.

## Exercise 10

Is this a definition or a declaration?

```
class exam {
  vector<int> score_per_question;
  int total_score;
  void CalculateScore();
}
```

## Exercise 11

Write a function `void shuffle(const vector<int> &v, const vector<int> &w)` that that takes two arrays `v` and `w` and writes in the standard output the values by taking alternately one element from each of v and w. Assume `v.size()==w.size()`.

## Exercise 12

Write a method `int countDivisors(int n)` that returns the number of divisors of `n` for `n`≥ 0.

## Exercise 13

Write a function `int[] histogram(const vector<int> &timestamps)` that receives a vector of integers representing the orinal number of time intervals of 5 minutes in a day, eg, "00:00-00:05" is represented by the integer 0, "00:05-00:10" by the integer 1 and so forth and writes in the standard output a column of numbers of length `60/5*24` whose `i` row contains the number of occurrences of the `i`-th interval in `timestamps`.

## Exercise 14

Complete the following program to compute the square root of 64 with the words missing in the two places where underscores are typed:

```
#include <iostream>
#include <___>
using namespace std;

int main() {
  int x = 64;
  cout << ___(x);
  return 0;
}
```

## Exercise 15

Correct the following piece of code:

```
#include<iostream>

void do_smth() {
   cout<<''Smth from N1''<<endl;
}

void do_smth() {
   cout<<''Smth from N2''<<endl;
}
```

```
int main() {
  do_smth(); // it must print N2
  return(0);
}
```

## Exercise 16

Predict the output of following C++ program?

```
#include<iostream>
using namespace std;

int main()
{
  const int x = 10;
  int y = x;
  y = 20;
  cout << "x = " << x << ’’; ’’ ;
  const int &ref = y;
  y = 30;
  cout << "ref = " << ref << endl;
  return 0;
}
```

  x =
ref =

## Exercise 17

Handle the error of a wrong input (i.e., not a number) in this piece of code:

```
#include<iostream>
using namespace std;

double calc() {
  cout<<"Type a number: ";
  double val = 0;
  cin >> val;
  return 10/val;
}

int main()
{
  cout << calc() << '\n';
  return(EXIT_SUCCESS);
}
```

## Exercise 18

Consider the following piece of code:

```
#include<iostream>
#include<vector>
using namespace std;

string punctuation{";:,.?!(){}<>/&$@#%^*|~"};

int main()
{
  vector<string> vs;
  for (string word; cin>>word; )
    {
      if (word == "quit")
  break;
      vs.push_back(word); // read words
    }

  for (string &w : vs) {
    remove_punctuation(w);
  }
  for (string &w : vs) {
    cout << w << '\n';
  }

  return(EXIT_SUCCESS);
}
```

Define the function `remove_punctuation` such that it removes in place the punctuation and substitutes it with a whitespace character.

**Exercise 19** What will be the output of these two lines if part of a correct program?

```
string food = "Pizza";
cout << &food;
```

A Compiler error

B Abnormal program termination

C Program doesn't print anything and terminates normally

D "Pizza"

E A number in hexadecimal base representing the address of the variable `food`